

Report of the Noise Abatement Working Group of the Air Carrier
Operations Subcommittee: Aviation Rulemaking Advisory Committee

The Noise Abatement Working Group held its first meeting in Washington, D.C. on June 27, 1991. This working group was assigned the following task: "Determine close-in (flaps down) and distant (flaps up) standard takeoff profiles and prepare material for incorporation into an Advisory Circular (these profiles were also to provide safe takeoff and initial climb performance criteria on a nation-wide basis)." During the first meeting, and the second on July 24, 1991, the working group reviewed the results of an informal joint FAA/industry task force which had previously studied the safety aspects of takeoff noise abatement procedures (see enclosure #1). The working group has discussed in detail the need for standardization and the establishment of minimum performance criteria for noise abatement takeoff profiles. The working group believes it has accomplished its assigned task and makes the following recommendations.

1. The minimum performance criteria of enclosure #2 should be incorporated into an AC.
2. The guidelines in enclosure #3 for selection of noise abatement takeoff profiles should be formalized.
3. In the interest of ensuring an orderly transition in the adoption of the performance criteria described in enclosure
2 ~~#1~~ it is recommended that the FAA implement subsequent
WE takeoff noise abatement profiles through air carrier Operations Specifications at an appropriate time. In addition, at airports where current air carrier operations are not compatible with the performance criteria in
2 ~~enclosure #1~~ it is recommended that the FAA coordinate
WE appropriate agreements and arrangements with the affected airports and, if appropriate, the affected air carriers.
4. Although some preliminary noise assessments have been accomplished with data from a B737-300 simulator, more work is needed to ensure that a process is available to assess whether any proposed takeoff profile does in fact offer sufficient noise abatement to justify its use. Accordingly, assessments of which departure profile is preferable from environmental standpoints, including noise abatement and energy conservation, require consideration of aircraft type and the variety of airport conditions including the locations of affected noise sensitive areas. In the interest of developing a method and data base for assessing the community noise benefit (or non-benefit) of the noise abatement takeoff profiles, it is recommended that the FAA

establish a working group to accomplish this activity.

5. The group recommends that the FAA assign a working group to investigate the possibility of utilizing a flight engineer in lieu of an automatic thrust advance system for the purpose of defining a minimum cutback thrust level.

The working group also recommends that the FAA develop policy that ensures that operators may not use a normal procedure that prescribes the initiation of a power change (reduction) before attaining 800 feet AGL.



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Att. Mr. Wes Euler

your letter/reference

our reference

date

173-91

24th April 1991.

Subject: Noise abatement cutback, revision to draft AC 91-53A.

- Ref.1. Joint FAA/Industry take-off noise abatement meeting on March 13, 1991.
2. FAA letter dated May 15, 1989 to Fokker signed by ANM-200/Mr. T.J. Howard.
 3. Fokker letter EQ/90-0387/AO/MA dated March 29, 1990 to the FAA.
 4. FAA letter dated April 19, 1990 to Fokker signed by Mr. Daniel C. Beaudette Director Flight Standards Service.
 5. Fokker datafax to FAA/Mr. Wes Euler dated 21 March 1991 Take-off noise levels Fokker 100.

Dear Mr. Euler!

During ref. 1. meeting Fokker took an action item to explain why we were not in favour of raising the cutback altitude to 800 ft minimum. The following outlines our criticism in 6 chapters, i.e. Approvals, 800 ft cutback altitude, Noise, Safety, Future and Summary/conclusion.



A. Approvals

The Fokker 100 Noise Abatement Profile (NAP) has been certified by RLD & FAA for Orange County (SNA) only, see App. I.
This was fully in line with a basic understanding from FAA that, subject to verification, the system could be approved, see ref. 4.

Raising the cutback altitude to 800 ft would

- make the above approval useless both for E and AA class operations, at Orange County
- make most of the Fokker 100 NAP features redundant or even penalize the Fokker 100 more than other aircraft not having such a system, for explanation see item C.

B. 800 ft Cutback altitude.

As for the working group recommendations attachment 2 - pages 4 thru 6 on initiating altitude, we believe that 800 ft is not necessarily safer than 400 ft, because this has to be weighed against how the cutback is performed, the particular aircraft configuration, equipment & systems layout, etc.

A review of the additional reasons 1 thru 8 of att. 2-4/5 with respect to the Fokker 100 yields the following:

1. A Fokker 100 usually achieves a stable flight path at 100-200ft (YES, IT IS A VERY EASY AIRCRAFT TO FLY!)
After cutback, the system controls to approx 1100ft/min regardless of partial thrust loss or down draft.
2. The F100 has a fully integrated windshear escape guidance also available on autopilot with automatic firewall thrust selection between lift off and 1500 ft.
Wingtip vortex encounters leading to speedloss are fully covered thru the NAP protection systems, see also item D.
- 3&4 Fokker 100 AFCAS consists of a high integrity monitoring system that allows category 3B autolands and redundant take off's from 35 ft.
Autopilot capability from 35 ft gives the crew maximum capability to exercise external vigilance.

We find it inconceivable that a hightech auto flight control system - with all its pre engage safety checks and post engage monitoring can be used for an automatic landing but not immediately after take-off.

Please note that on the Fokker 100 it is not possible to engage into unsafe conditions.



5. The Fokker 100 NAP does not require clean-up before thrust reduction. In addition, flaps zero will be the preferred configuration because it has the best L/D ratio, hence leads almost always to lowest noise on the ground.
6. The Fokker 100 avionics system allows FMS NAV to be armed on the ground. If such a take off is performed NAV auto engages at 35 ft providing further relief to the pilots.
7. While it is true that Fokker 100 NAP requires extra training we firmly believe this to be minimal because of the simplicity, the clear task allocation PF-PNF and the fact that the emergency procedures are the same as normal emergency procedures, see also item D.
8. Between 500 & 1000ft, TCAS has full operational capability excluding descend commands. It is true that full TCAS incl. descent commands will be available earlier (~7 sec. at 1000ft on Fokker 100) however the safety benefit of this is doubted, since the least likely to occur are TCAS descend commands because of the vertical speeds achieved after liftoff. Noise Abatement Takeoff performed with the Fokker 100 results in a minimum vertical speed of 1100fpm, achieved at approx. 800ft AAE. Therefore, TCAS capability can hardly be a reason for the cutback altitude to be 800ft.

C. Noise.

As already outlined in our fax, ref.5, raising the cutback altitude to 800 ft puts medium by pass ratio engines (the TAY = 3:1) at a competitive disadvantage especially when close to the airport.

% See. APP.II.

Another big disadvantage of a minimum cutback altitude of 800ft instead of 400ft is that a lot of flexibility to optimize the NAP procedure for the relevant local situation is lost. We have added 75 dB noise footprints for representative Fokker 100 take off weights for 85000 & 90.000lb, i.e. average loadfactors for 300 and 500nm trips,

% See APP. III.

While the areas are rather close, the shapes are not. When the noise-sensitive area's are located close to the airport, a cut-back altitude of 400 instead of 800ft will provide substantial noise benefit's.

This is the very reason that we incorporated in our NAP system the possibility to safely initiate cutback at any desired altitude starting from 400 ft.

Finally, in order to permit safe cutback at 400ft, the Fokker 100 NAP system incorporates safety features beyond Draft AC 91-53A. One of these features results in a noise penalty compared to aircraft not having similar protection, as we will explain:



In the Fokker 100 NAP system, the thrust cutback is controlled to follow the pilotcontrolled pitch attitude, with the result that the NEPR target is reached at approx. 400ft above the thrust cutback initiation altitude. The proposed rules with 800 ft minimum cutback altitude would not require the thrust cutback to be automatically controlled. A manually set cutback thrust, and hence the corresponding noise reduction, would be achieved more rapidly, e.g. at 200 ft above cutback initiation. In order to avoid a noise penalty compared to aircraft using manual cutback, the automatic feature would have to be removed, which in our view would reduce safety.

D. Safety

A proper understanding of the safety issues involved has to start with the Fokker 100 Flight Deck Design objectives. The most important are:

1. Simple and straight forward operation.
2. Keep the pilot in the loop.

The NAP procedure has been summarized in App. IV.

% App. IV. The NAP procedure reviewed against the above principles gives:

Ad 1 - NAP procedure itself is simple and straight forward. Apart from arming the system on the Flight Mode Panel (NAP button) the only other action is pushing Climb (CLB) on the (MFDS) thrustrating panel.

- Clear task allocation PF-PNF
- Standard emergency procedures

% For these last two items Crew Resource Management has been implemented as can be observed from the Flight Manual text, see app.V.

Ad 2 - The pilot is kept in the loop because

- Thrust cutback "NEPR" value is displayed on the MFDU throughout NAP-take-off

% App. VI Summarizes the NEPR target computation, being automatic & continuous based on all relevant parameters.

- NAP mode annunciation on the Flight Mode Annunciation (FMA) on EFIS for normal, abnormal and emergency situations.

% App. VII Outlines three abnormal/emergency situation including presentation to the pilot as follows:

Sht.1: Aircraft flies in vertical speed with NEPR (noise abatement thrust) established, speed is open in second phase when speed, which was $V_2 + 10$, is lost (eg due to windshear) i.e. less than $V_2 + 5$, the system automatically reverts to speed on throttle.



Sht.2: NAP is armed but not active. The LH engine fails the system automatically disarms NAP, the RH engine automatically to controls to the autoselected T.O. thrust limit.

Sht.3: NAP is active, the LH engine fails. NAP is deactivated. Automatic reversion to TO mode follows. Again this is clearly indicated to the pilot both on the FMA and on the MFDS (engine indication. Actual Speed ($V_2 + 10$) becomes reference.

The above system not only fully meets draft AC.91.53A, but has several safety features that go beyond this draft AC as follows.

- After cutback, vertical speed control ensures a constant rate of climb of approx 1100 ft/min regardless of partial thrustloss, down draft or windshear. For protection mechanism's summary see app. IV sht. 3.
- Thrust cutback follows pitch attitude causing a controlled thrust reduction. NEPR target is achieved at approx 400 ft above cutback altitude.
- Engine failure & windshear procedures are identical for both normal and NAP take-off.
- Autopilot capability is available to perform NAP.

In view of the foregoing Fokker firmly believes its NAP system with cutbacks starting at 400ft, to be inherently more safe than cutback systems and procedures at 800ft following the suggestions of the noise working group.

This is primarily because of

- The extra safety features as described before.
- The low workload, which has been reduced to the absolute minimum within the current certification requirements, see app. VIII.

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In fact Fokker believes that NAP take-off with a Fokker 100 at 400ft cutback altitude is safer than a take-off performed with most other airplanes using 800ft cutback altitude.

E. Future.

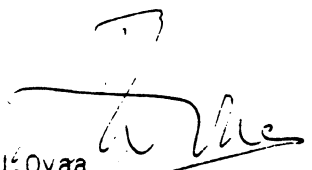
Fokker believes that the revised noise take-off rules as proposed by the noise working group discourages future developments. The fact that no credit is given for advanced and/or redundant systems, other than automatic thrust restoration following engine failure, is a significant point in this respect.



F. Summary & Conclusion.

Fokker believes that, apart from serious economic impact for Fokker - the NAP system was extensively modified following ref.2, which now seems at least superfluous - the new proposed rules are counter-productive to the noise groups intentions for two reasons, viz.

- a. 800ft cutback favours high bypass ratio engines more than medium/low bypass ratio engines.
It should be noted that the stage 3 noise rules can be beaten by large margins by both types of engine aircraft combinations!
- b. The net safety gain by raising the cutback altitude to 800ft will be more than offset by the negative safety aspects of mainly manual cutback procedures as now proposed, since there is no incentive to incorporate advanced/redundant systems.


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Sincerely Yours


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